The Schematism of Natural Language

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Abstract

The discussion in this article starts with an object-based description of natural language. By examining the relations imposed on language and contrasting them with the relations in a subject-based model, the author shows the importance of incorporating subjectivity into language formalism. The alternative presented is based on the identification of the agent function and presupposes that discrimination between perspective and objective be formalized. The way in which detection of the scope of observation determines the subjective meaning of a sentence is demonstrated.

The Instrumentation of Language

Language processing can hardly be discussed without a statement of the fundamentals on which the instrumentation rests. The models and their operationalization express the linguist's starting-points, more or less conscious, when he faces the phenomenon of language. A commonly accepted position in linguistics is that language is a set of culturally transmitted conventions. The language describing these conventions is called a linguistic model when it forms some systematics. To linguists this instrument contains implicit and thus self-evident relationships between language and its description. In the study of human functions related to intelligent behaviour, these relationships have to be made explicit, since there is no way of circumventing language in dealing with cognitive phenomena. Consequently, in the search for a cognitive mechanism, language has an instrumental function.

A central notion related to language processing is " schema ". In the following I will try to show the double sense of this notion.

Schemata, in the linguistic sense, are self-contained units differing in rank. The fundamental schema is the sentence, which has the highest rank. It may contain subschemas of the same type (coordination) or of a different type (subordination). Because of the first fact, the sentence schema as a descriptive instrument is called a clause. Example (1) illustrates the formalism describing the main clause in certain natural languages (Diderichsen, 1962).

$$k \left(\begin{smallmatrix} S \\ A \end{smallmatrix} (v \; s \; a \; (V \; S \; A \;))) \right) \tag{1}$$

From this rank, coordination can be generated (k) as well as subschemas. By a combination of word types (verb, substantive noun, and adverb) taking up pre-determined positions, recurrent patterns are formed when the schema operates. Formal changes are steered from the initial state (" fundament ").

The structural approach in linguistics often conceives of

language as an organ, and seeks to identify the basic mechanisms that make the organ function. The strategies are all based on the premise that structure is contained in the form and that the recurrent functioning of language mechanics, consequently, expresses both. The hypothesis of an isomorphic relationship between representation and phenomenon is binding on model formulation. Thus, before interpretation, it becomes necessary to inquire into the meaning of the link (Woods, 1975).

The Representational Link

The model that can be generalized from the sentence schema (1) is S V O, which states the relationships between the subject, the verb, and the object in representing syntactic operation. The foundation of this process is the following:

$$S \rightleftharpoons V \leftarrow O \tag{2}$$

The double arrow represents the nexus, i.e. the privilege of co-occurrence between subject and verb, whereas the one-way arrow represents the determining function of the object. Both links explain the phenomenon in terms of association. The imperative of association objectifies not only the object in relation to the subject, but also the subject itself. This conception of the link is the governing mechanism for the framing of language behaviour as standard behaviour and interpretation as a function of common sense.

Object-governed processing is the root of language analysis. If, however, a synthesis is to be achieved, the governing mechanism has to control the perspective. A synthetically based schema is conceptualized in the Agent-action-Objective model:

$$A \rightarrow a \rightarrow O \tag{3}$$

The two one-way arrows represent transitivity, which is to be conceived as a strict dependency between agent and objective. This affinity is effected by the action component (Bierschenk & Bier-

schenk, 1976). Since the schematism for synthesis is an integrant part of development, it should be founded on a theory of action (Piaget, 1978), and thus impose intention on the definition and interpretation of the objective component. Governing in the processing of language must, therefore, be that subject and predicate cannot be understood independently of each other (Bierschenk, 1984).

To incorporate the intentional component into the operationalization of a model is to agree on the indispensability of context. In the following section I will present a model for language processing in which objectivity could be enhanced by control of the perspective.

Control of Perspective

Natural language is ecological in the sense that it passes on information about our conduct to our environment (including other people) and to our thoughts and ideas. The ecological position in research on human functions conceives of the individual as a purposely acting organism, which preserves experience in its behaviour by structuring and transforming both itself and its environment. The leading idea is that regularized behaviour becomes symbolic. Of central importance to text processing, then, is to search for knowledge of the way in which language expresses experience and its change.

A text may be regarded as the expression of an agent's (A) cooperation (a) with some environment (O). If the expression

The researchers studied infants   (4)

is an observation of empirical relations of a certain specific environment, then this relation is given between agent and objective each time they appear in the same observation. The infants are objectives at the level where the researchers are agents, that is, at the empirical observation level. This level specifies the scope of observation valid for this environment. Thus, by determining the empirical agent it becomes possible to control the perspective,

which is particularly important when the levels of processing shift. Compare these two levels.

$$(\text{The researchers observed that} \qquad (5)$$
$$(\text{ some infants crawled over the edge }))$$

Once the perspective has been defined, two levels of processing can be discerned: The observation level (outer perspective) and the action level (inner perspective). If there is a change of perspective, the objective is given the function of agent in the observation, which implies that the action level is controlled by the observer. This paradigmatic relation can be formalized as

$$(A \; a \; (A \; a \; O, \; A \; a \; O, \; ... \;)) \qquad (6)$$

Central to schematism is transformation, which may be conceived as a process that incorporates variability in the points of observation as a function of change in scope. Since every point of observation is a possible point of view, it is necessary to discern the viewpoints in relation to the scope. (The operationalization of such a process will be described elsewhere.)

Empirical Foundation

To test whether language contains components that can pick up ecologically valid information, a text was used, one which describes an internationally well-known and renowned experiment in child psychology (Gibson & Walk, 1960). Its contextual relations are, briefly, the following.

A group of researchers was interested in the extent to which the meaning of depth could be shown to exist in infants of crawling age. An experimental device was constructed, which looked like a large table surrounded by a border. The table top was made of glass and was arranged so that half its surface became " shallow " with checker-squared material placed underneath it and the other half " deep " with the material lowered on to

the floor. In this way a dangerous situation could
be simulated. The infants were placed on the glass
surface, and by using their mothers to lure them
to cross the table to either side, the researhers
were able to observe what kind of behaviour the mo-
thers elicited in the infants.

In order to detect the scope it is important to be able to decide
whether a grammatical transformation is isomorphic to a structur-
al one. One observation in the text is worded

The infants had to be lured into locomotion   (7)
by their mothers

This grammatical transformation from an active to a passive sen-
tence with the use of the preposition by marks the functional
change of a constituent. Traditionally, constituents are supplied
with meaning, as defined in a semantic frame of reference. Since
this meaning cannot change as a result of a grammatical trans-
formation, the preposition is taken to mark the agent's change of
position. If, however, the positional interpretation is abandoned
in favour of the functional, then there is no need for a semantic
theory because the instrumental function of by picks up the per-
spective meaning of the sentence.

References

Bierschenk, B. Steering mechanisms for knowability. Cognitive
    Science Research (Lund: Lund University), 1984, No. 1.

Bierschenk, B. & Bierschenk, I. A system for a computer-based
    content analysis of interview data. (Studia Psychologica et
    Paedagogica, No. 32.) Lund: Gleerup, 1976.

Diderichsen, P. Elementaer dansk grammatik. København: Gyldendal,
    1962.

Gibson, E.J. & Walk, R.D. The " Visual Cliff ". Scientific Amer-
    ican, 1960, 202 (4), 64-71.

Piaget, J. Behavior and evolution. New York: Pantheon Books, 1978.

Woods, W.A. What's in the link: Foundations for semantic net-
    works. In D.G. Bobrow & A. Collins (Eds.) <u>Representation
    and understanding: Studies in cognitive science</u>. New York:
    Academic Press, 1975. Pp. 35-82.